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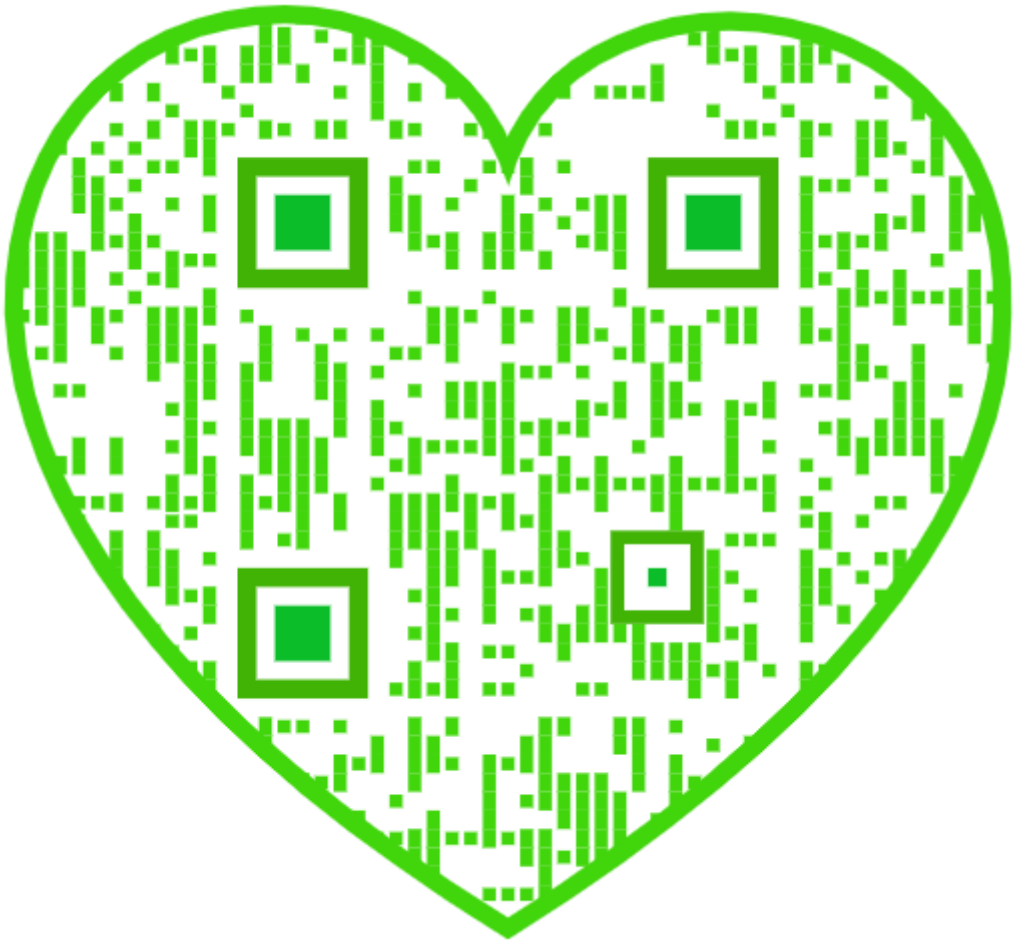

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DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HUGH M. SMITH, Commissioner

ARTIFICIAL PROPAGATION OF STURGEON

REVIEW OF STURGEON CULTURE IN THE UNITED STATES

By GLEN C. LEACH
Assistant in Charge Division of Fish Culture
U. S. Bureau of Fisheries

and

ARTIFICIAL PROPAGATION OF STURGEON IN RUSSIA

By NICOLAS A. BORODIN
Formerly Chief Specialist in Fish Culture
Russian Department of Agriculture

APPENDIX III TO THE REPORT OF THE U. S. COMMISSIONER OF FISHERIES FOR 1919

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ARTIFICIAL PROPAGATION OF STURGEON.

Part 1. REVIEW OF STURGEON CULTURE IN THE UNITED STATES.

By Glen C. Leach,
Assistant in Charge Division of Fish Culture, U. S. Bureau of Fisheries.

A number of attempts have been made in the United States at various times to propagate the sturgeon by the artificial manipulation of the eggs, but in every instance they have been rendered practically null by certain unusually persistent difficulties. An account of the efforts may be of interest and value, particularly in view of the fact, as appears from the accompanying paper of Prof. N. A. Borodin, formerly connected with the Russian department of agriculture, that most of these obstacles were overcome in the course of some experimental work performed under his direction as chief specialist in fish culture in that department.

The first attempt at sturgeon propagation by a representative of the United States Government was in 1888 at Delaware City, Del., in the course of an investigation of the sturgeon fishery by Dr. John A. Ryder (Bulletin, U. S. Fish Commission, 1888), but experiments along that line had been conducted by Seth Green at New Hamburg, N. Y., as early as 1875, and were described by him in his book entitled "Fish Hatching and Fish Catching," published at Rochester in 1879.

The eggs for the experiment at Delaware City were obtained from fish landed for the market. A number of such fish were examined, but of the various lots of eggs secured only one small lot was successfully hatched. In this instance they were taken by opening the female fish, and after fertilization had been accomplished by the application of milt secured in the customary manner, the eggs were spread in a single layer over the cheesecloth bottoms of shallow boxes and anchored in a small sluiceway where there was a constant current of water.

The same drawbacks—viz; difficulty in finding ripe eggs and milt at the same time, imperfect aeration of the eggs during the incubation period, and the unusual tendency of the eggs to develop fungus—were again encountered in the course of a second attempt to propagate sturgeon at Delaware City by Dr. Bashford Dean in 1893. The work of that year disclosed the feasibility of using as a fertilizing medium milt secured by the removal of testes from male fish which

were not sufficiently matured to void the secretion by the application of external pressure. The milt was separated from the cut testes by straining through a coarse cloth and proved just as effective as that taken from live fish, even after being held for several minutes in the rubber-bulb container. In an effort to overcome past troubles, the style of hatching apparatus was changed. The eggs were spread evenly under water on shallow trays in boxes whose sides and bottoms were covered with metal gauze. The necessity for quick handling soon became apparent, as the viscid nature of the eggs causes them to cling so firmly to any surface with which they come in contact that they are invariably injured in the attempt to loosen them, and it was found that if not placed on the trays within 10 or 15 minutes after being fertilized they would form into a gluelike mass, which speedily became compact and hard. After allowing sufficient time for the eggs to become firmly attached, the trays containing them were fitted into the boxes and anchored in various places in the river bed.

By the end of the second day thereafter the eggs in the boxes, which had been moored in marginal waters having a sluggish current and carrying much silt, were found to be entirely enveloped in fungus and dead. Those placed where the water current was strong and comparatively free from sediment had sustained a loss of 60 per cent by the close of the fifth day from the same cause, while those which had been installed in a strong current in salt water showed practically no fungoid growth and were hatched in good condition.

In the spring of 1890 Frank N. Clark, superintendent of the Northville (Mich.) station, made preparations for the collection of sturgeon eggs at Fox Island, Mich., and under his direction 142 female and 32 male fish were examined between May 26 and June 14. Examination showed that 23 of the females had already spawned, 98 were very immature, the eggs in 6 were nearly ripe, and 5 were in spawning condition. Of the males 21 were hard, 2 almost mature, and 9 entirely so. In all, 20,000 eggs were secured and fertilized by cutting open and squeezing the milt sacs after moistening them with water. Much difficulty was experienced from adhesion, three hours of constant stirring being required to break up and separate the bunches of eggs. Ninety-five per cent of them were developed to the eyed stage, but shortly afterwards a growth of fungus began spreading in the floating boxes in which they were being incubated, and, as a result, very few of the eggs were hatched. Had it been possible to incubate them in whitefish jars it is estimated that at least 85 per cent would have been saved.

In the course of experimental work conducted in 1901 on the Missisquoi and Lamoille Rivers, tributary to Lake Champlain, efforts were made to hold green sturgeon in artificial inclosures for ripening. These efforts proved utterly futile, as in every instance the eggs caked together in a hard mass and development was arrested. Notwithstanding the great difficulty experienced in securing ripe eggs and milt together, 1,500,000 eggs were taken and fertilized, and their viscosity was effectively overcome by the method that is employed for the separation of pike-perch eggs. They were then successfully hatched in McDonald jars, the incubation period being

about six days in a water temperature of 65° F. The fish from which they were secured were taken especially for the work, and their violent struggles when caught frequently resulted in the loss of many of their eggs. Such losses were unavoidable, as it was possible to distinguish a ripe female only when the eggs ran from it after it was taken from the water.

In 1911 experimental sturgeon propagation was undertaken in Minnesota in the Lake of the Woods region. In advance of the season's run of fish an inclosure large enough to hold 30 adult sturgeon was constructed in Rainy River, and a hatching apparatus of sufficient capacity to accommodate 3,000,000 eggs and fry was set up in a convenient building. During the spring 16 sturgeon were captured in a pound net and transferred to the pen. Though held for several months under apparently favorable conditions, they failed to mature, and in the following October they were released without having produced any eggs. Another trial was made in the following year with the same results.

From the observations made it was concluded that sturgeon do not spawn until the water has attained a temperature of 60° F.; that the eggs do not ripen in fish held in confinement; and that unless nearly ripe males are available when the eggs are taken no results can be expected. The spawning season at the various grounds has always been short, seldom exceeding three or four days. It is believed that jars similar to those used in the propagation of whitefish and pike perch are the most suitable form of equipment for the development of sturgeon eggs.

Part 2. ARTIFICIAL PROPAGATION OF STURGEON IN RUSSIA.

By Nicolas A. Borodin,
Formerly Chief Specialist in Fish Culture, Russian Department of Agriculture.

Every fish-culturist knows how difficult it has been to secure any genuine success in the artificial propagation of any species of sturgeon of the genus Acipenser. There must be acknowledged almost complete failure in both America and Europe as far as practical results go. One drawback has been the difficulty of keeping sturgeon eggs alive and sound, owing to their liability to be attacked and killed by Saprolegnia and other kinds of fungus. Yet another and very serious matter has been the scarcity of sturgeon in the rivers and lakes; in fact, these fish in many waters have become practically exterminated, and there has been no possibility of securing ripe eggs.

While America and western Europe have lost most of their sturgeon supplies, Russia still remains rich in sturgeons, especially the rivers emptying into the Caspian Sea—the Volga, the Kura, and the Ural. Even in these waters, however, there has occurred positive diminution in the number of sturgeon, and it is the general belief that, in order to prevent the entire extermination of these fish, it is quite necessary to resort to artificial propagation on a large scale.

Just prior to the outbreak of the war the central administration of the fisheries in Russia received a special appropriation for sturgeon propagation. Three of the commercial species were selected for attention, namely, *Acipenser ruthenus*, a small fish living in the Volga; and *A. guldenstadti*, a Russian sturgeon and *A. stellatus*, or starry sturgeon, both living in the Caspian Sea and ascending the Volga, Kura, and Ural Rivers in spring. Temporary stations for the propagation of *A. ruthenus* were established and operated in the Volga in 1913, 1914, and 1915; one station for the propagation of *A. guldenstadti* was erected on the Ural in 1915, and another on the Kura in 1914, for handling both the starry and the Russian sturgeons.

There are not at hand the exact data on the work accomplished as regards the number of eggs hatched and fry planted, but the figures for *A. ruthenus* run into tens of thousands and for *A. stellatus* and *A. guldenstadti* into several hundreds of thousands. Most of the fry were planted several days after hatching, but a considerable number of fry of the Russian sturgeon were reared for several months, and some specimens were carried in an aquarium for five or six months, until they became too large for their quarters.

There have been some interesting developments in sturgeon propagation in Russia in the past few years, and I will try to describe the methods employed.

Two of the most important deductions from the investigations made during the experimental work are that sturgeon eggs become ripe and suitable for impregnation only when the male and female fish are kept together in the same pond or reservoir and that the spawning act takes place probably only at night. These two observations explain why it has always been very difficult to get ripe eggs from sturgeons caught during daytime or kept in ponds or inclosures with the male and female fish in separate compartments.

In our experiments, specimens of *A. ruthenus* have been held in large ponds, and their eggs have become ripe. Russian sturgeon have been retained in a reservoir about 32 feet long, 11 feet wide, and 6 feet deep, supplied with a current of water pumped directly from the Ural River. One night these fish spawned, and two days later there were found in the mud at the bottom of the pond thousands of eggs. Some of these fish hatched into healthy fry, but, as is always the case under natural conditions, most of them had not been fertilized, and therefore they perished.

With regard to artificial propagation of sturgeon, as elaborated by Russian fish-culturists in the latest work, the methods have been as follows: As the eggs flow from the female sturgeon they have a tendency to become united into a glutinous mass, which must at once be prevented. We received good results by stripping the eggs into a wire screen, washing them thoroughly with river water, and then putting them in a tin pan and fertilizing them with milt diluted with water. Several minutes later, before the eggs had become sticky, we again washed them thoroughly with river water, which at this time in the Ural and Kura Rivers is very turbid and of a yellow color, because of the enormous quantity of clay and sand in suspension. By such use of muddy river water analogous to the employment of swamp muck or of starch for overcoming the adhesiveness of pike-perch eggs in the United States, we counteracted the stickiness of the sturgeon eggs, which thereafter lose that quality and become easy to handle in any fish-hatching apparatus. We obtained quite good results in using two very different kinds of apparatus, namely, the Williamson trough and the Chase jar; but in both cases we preferred to employ not running water, which is always a little muddy, but filtered water without circulation and with constant aeration.

After three or four days of development the eggs hatched, and thousands of fry were obtained. For the first four or five days the young do not require any external food, having a sufficient quantity of nourishment in their yolk sac; but after that period we introduced into the troughs and jars living food consisting of the smallest fresh-water crustaceans (Daphnia, Bosmina, etc.) collected in small, warm waters with fine-meshed nets. The fry soon begin to search for these crustaceans. When they become larger and accustomed to take food, we begin to feed with chopped earthworms, of which young sturgeon are very fond. Fed in this way sturgeon grow very rapidly, attaining during the first month a length of about 1½ inches and during five months 10 to 11 inches. Fry of two to three months have already begun to closely resemble the adults and are very pretty fish.

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